DESIGN AND FABRICATION OF A MOBILE OPERATED WATER CLEANING DEVICE

[1]PROF. ROHIT SHARMA [2]TEJAS CHOUDHARY [3]RUTHIK MESHRAM [4]PAWAN GAJBHIYE
[5]PRASHIK GOSWAMI [6]ARPIT GAIKWAD

UG STUDENT

DEPARTMENT OF MECHANICAL ENGINEERINGJD

COLLEGE OF ENGINEERING AND MANAGEMENT,

NAGPUR.

Abstract—: This project focuses on the design and development of a mobile-operated device for cleaning river water. The motivation behind this project stems from the dire condition of our national rivers, which are inundated with vast quantities of sewage, pollutants, toxic materials, and debris. The Indian government has undertaken significant initiatives, such as "Namami Gange" and "Narmada Bachao," as well as various city-specific river cleaning projects in places like Ahmedabad and Varanasi. In response to this pressing issue, we have designed a machine to effectively clean the surface of river water.

In today's manufacturing landscape, there is a strong emphasis on automation to expedite production processes. Automation plays a pivotal role in mass production by reducing the need for manual labor and minimizing the time required for tasks. In our project, we have fabricated a remote-operated river water cleaning device to automate the process of river cleaning. The primary objective is to decrease the dependency on human labor and streamline the river cleaning procedure.

Our automation system is reliant on a motor and chain drive arrangement, controlled remotely through RF (Radio Frequency) transmission. Automation can be implemented using various technologies, including computers, hydraulics, pneumatics, and robotics. Among these options, pneumatics offer an economical and effective means of achieving automation for this particular application.

Keywords: four-wheel steering, 4WS, mechanical 4WS, hydraulic 4WS, handling, maneuverability, safety.

1. INTRODUCTION

Water is the essence of life, an irreplaceable and fundamental resource that sustains all living organisms on Earth. Access to clean and safe drinking water is not just a basic necessity but a fundamental human right. Yet, in our rapidly changing world, the availability and quality of water sources are under increasing threat. Pollution, industrialization, climate change, and population growth have placed immense pressure on our water systems. As a result, millions of people around the globe face the daunting challenge of accessing water that is free from contaminants and safe for consumption. Moreover, the environmental repercussions of water pollution are profound, affecting not only ecosystems but also biodiversity and the delicate balance of our planet's ecology.

In response to this pressing global concern, this thesis embarks on a comprehensive exploration into the realm of water purification and environmental engineering. We aim to design and fabricate a device that goes beyond conventional water treatment methods. This innovation combines cutting-edge technology and engineering prowess to create a "Mobile Operated Water Cleaning Device." This device represents a paradigm shift in how we approach water purification, leveraging the power of mobile technology to provide immediate, portable, and sustainable solutions to the ever-escalating water pollution crisis.

In this expansive and deeply researched thesis, we embark on an intellectual journey that navigates through the intricacies of water pollution, the significance of access to clean water, and the potential of technological innovation to address these global challenges. The introduction serves as the anchor of our exploration, setting the stage for the chapters to come by providing the necessary background, articulating the problem statement, defining our objectives, emphasizing the significance of our research, and delineating the scope and limitations that frame our study.

FIG: 1 Sewage, Toxic materials, and debris in river

The impurities (Shown in FIG.1) found in water can pose significant health and environmental hazards of drainage systems, their primary function is to gather, transport, and dispose of water through designated outlets. Impurities in drainage water typically comprise items like empty bottles, plastic bags, and paper, among others. This project presents an industrial working prototype of a solar-powered water cleaning mechanism capable of autonomously collecting floating garbage and solid waste from the water's surface and depositing it into a floating bin. This system is adaptable, scalable, and can be operated remotely. Furthermore, it is a homegrown solution known for its efficiency in addressing the issue of river cleaning. The "River cleanup machine" used in that placeswhere there is waste debris in the water body which are to be removed. This machine is consists of waterwheel driven conveyer mechanism

which collect & remove the wastage, garbage & plastic wastages from water bodies. This also reduce the difficulties which we face when collection of debris take place. A machine will lift the waste surface debris from the water bodies, this will

2. LITERATURE REVIEW

Mr. P. T. Date et al. (2017) This paper delves into the intricate design and manufacturing aspects of a river waste cleaning apparatus. It directly confronts the prevailing predicament concerning the dire state of our national rivers, which bear the heavy burden of sewage, pollutants, toxic substances, and debris. The Indian government has embarked on ambitious river restoration initiatives, exemplified by projects like "Namami Gange" and "Narmada Bachao," channeling substantial resources into the endeavor to rejuvenate these vital water bodies, particularly in urban centers like Ahmedabad and Varanasi. In response to this pressing challenge, the river waste cleaning machine was meticulously developed with the express purpose of efficiently cleansing the surface of river waters.

Conventional techniques for gathering floating debris in rivers typically entail manual labor or the utilization of equipment such as trash skimmers, culminating in the disposal of waste near the river's edge. Regrettably, these approaches are fraught with drawbacks, including high costs, labor intensiveness, and protracted cleaning durations. To rectify these limitations and optimize river surface cleansing methodologies, an innovative remote-operated river cleaning apparatus has been devised. This machine presents a potent, resourceful, and eco-conscious means of effectively purifying river surfaces.

Amol Jadhav et al (2014) Mechanical control methods play a pivotal role in the management and regulation of plant populations, involving the application of diverse mechanical techniques to either eliminate or diminish the proliferation of plants. These methods encompass a spectrum of activities, including harvesting, shredding, mowing, rototilling, rotovating, and chaining. They can also be employed to facilitate manual harvesting tasks, such as hand harvesting, raking, and cut stump control, by harnessing motor-driven machinery. The primary aim of employing mechanical control methods is to curtail the abundance of targeted plants to levels where they no longer pose a nuisance, rather than aiming for complete eradication of the species.

In aquatic environments, specialized machinery is specifically designed for the management and control of aquatic vegetation. These machines are tailored to address various types of aquatic plants and are well-suited for operation within particular aquatic habitats. A prime illustration of such equipment is the mechanical aquatic harvester, essentially a barge uniquely equipped to perform a range of tasks, including aquatic plant management and the removal of debris from rivers, lakes, bays, and harbors.

Shrishail Teradale et al. (2019) The waste collection process is executed through a conveyor blade that also captures sand during its operation. The sand is then released back onto the beach surface through perforations on the conveyor, while the waste materials are sorted based on the principle of density disparity. Within the machine, two separate hoppers are designated for collecting different types of waste, simplifying

ultimately resultin reduction ofwater pollution and lastly the aquatic animal's death to these problems will be reduced. It consists of Belt drive mechanism which lifts the debris from the water.

the subsequent disposal process.

In today's age, marked by the growing influence of digitization and automation, individuals, including the younger generation, increasingly seek convenience and intelligent solutions. To cater to this demand and enhance efficiency in waste management, an application dubbed the "Smart Cleaning System" has been meticulously developed. This innovative application empowers beach cleaners to carry out their tasks with precision and efficacy through seamless communication and coordination. The overarching goal of the Smart Cleaning System is to surmount real-time challenges and streamline the entire waste management process.

Ajay L. Krishnani et al. (2018) Water, a fundamental element for the sustenance of life on our planet, remains abundant; however, the majority of available water sources are not inherently suitable for direct consumption. The demand for clean water is consistently high, as it serves as a vital resource for a multitude of activities, including drinking, bathing, cleaning, and cooking. The presence of impurities in water poses a significant threat to human health, potentially resulting in severe consequences. Wastewater, encompassing the used water originating from residences, businesses, industries, commercial enterprises, and institutions, necessitates thorough treatment before it can be safely reintegrated into the environment. This essential purification process relies on a well-structured and engineered network of pipes and treatment facilities.

The quantity of wastewater subjected to treatment fluctuates, contingent upon factors like time of day and seasonal variations. The overarching objective of wastewater treatment is the removal and eradication of harmful substances and pollutants. By adopting wastewater treatment technologies that focus on removal rather than destruction of pollutants, a treatment residue is generated. Wastewater is categorized and defined based on its specific sources of origin. On average, each individual connected to the system contributes to the generation of roughly 200 to 500 liters of wastewater daily. This underscores the critical importance of efficient wastewater management to preserve the quality of our water resources and safeguard public health.

Madhavi N.Wagh et al. (2018) This project is focused on the development and analysis of a river water cleaning apparatus. The impetus behind this initiative arises from the dire condition of numerous national rivers in India, where pollution from sewage, noxious substances, debris, and contaminants has reached alarming levels. The Indian government has recognized the urgency of rejuvenating these rivers, prompting substantial investments in river cleaning endeavors like "Namami Gange," "Narmada Bachao," and prominent projects in urban centers like Ahmadabad and Varanasi. In response to this critical environmental concern, the river water cleaning machine has been conceived to combat the contamination of river water surfaces effectively.

In contemporary manufacturing practices, automation is pivotal for enhancing operational efficiency and productivity. In

alignment with this trend, the river cleaning machine's functionality has been automated through the integration of a motor and chain drive mechanism. The incorporation of automation serves multiple purposes, including precise control over the cleaning process. By utilizing RF transmitters and receivers, the cleaning machine can be remotely operated. Automation can be realized through diverse technologies like computers, hydraulics, pneumatics, and robotics. Among these options, pneumatics emerges as a compelling and cost-effective solution for achieving economical automation. This innovation is expressly focused on the development of skimmer devices tailored for the purpose of gathering and efficiently disposing of floating solid waste materials found in harbors and waterways.

3. REQUIRED COMPONENTS

1. Arduino UNO
2. DC Motor
3. DTMF decoder Module
4. Motor Driver L293D
5. 12 Volt Battery
6. Connecting wires
7. Zero PCB
8. Voltage Regulater Ic (7805,7808,7812)
9. Propeller Fans
10. Solar Pannel (12v 2A)

1. ARDUINO UNO

Arduino UNO is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

Features of Arduino UNO

Microcontroller - ATmega328P
Operating voltage   - 5V
Input voltage - 7-12V
Input voltage   - 6-20V
Digital I/O pins - 14 (of which 6 provide PWM output)
Pwm digital I/O pins - 6
Analog input pins   - 6
Dc current per I/O pin - 20 mA
Dc current for 3.3v pin - 50 mA
Flash memory - 32 KB of which 0.5 KB used by bootloader
SRAM - 2 KB (ATmega328P)
EEPROM - 1 KB (ATmega328P)
Clock speed - 16 MHz
LED built in - 13
Length - 68.6 mm
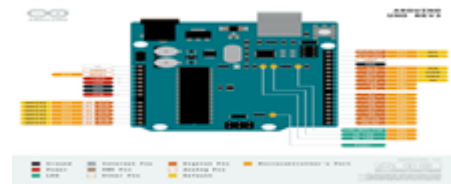Width - 53.4 mm
Weight - 25 g

FIG: 2 Arduino UNO

2. DC MOTOR

A DC motor is any motor within a class of electrical machines whereby direct current electrical power is converted into mechanical power. Most often, this type of motor relies on forces that magnetic fields produce. Regardless of the type, DC motors have some kind of internal mechanism, which is electronic or electromechanical. In both cases, the direction of current flow in part of the motor is changed periodically.

FIG: 3 DC Motor

3. DTMF MODULE

DTMF is a sort of a flagging framework, used to send the data through the telephone lines. The dual tone multifrequency is the flag of a telephone organization, it produces when you press a customary phone touch keys. In the United States or in different spots, it is known as a touch tone telephone dialing. Generally this innovation is utilized as a part of the cell phones with the correct methods and decoded DTMF flag is utilized as a part of the robotic microcontrollers to expand the robot execution to a specific activity as shown in Fig.4
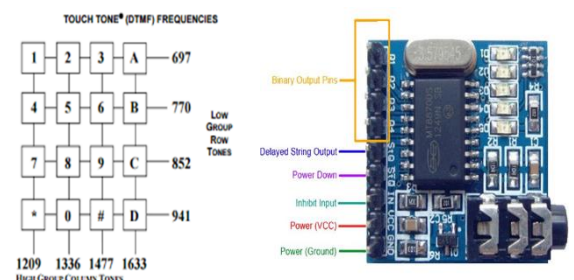

FIG: 4 DTMF Module

4. L293D MOTOR DRIVER

L293D has two arrangements of arrangements where 1 set has input 1, input 2, output1, output 2, with empower stick while other set has input 3 , input 4 , yield 3 , yield 4 with other empower stick. Here is a case of DC engine which is interfaced with L293D microcontroller.
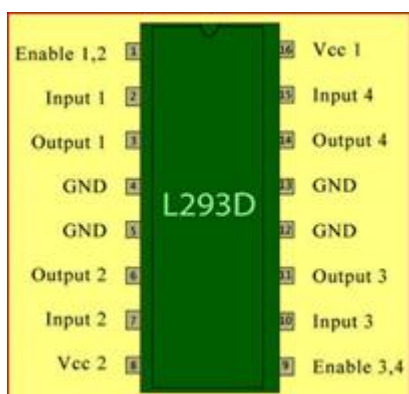
FIG: 5 L293D Motor Driver

5. BATTERY

Li-ion batteries can use a number of different materials as electrodes. The most common combination is that of lithium cobalt oxide (cathode) and graphite (anode), which is used in commercial portable electronic devices such as cellphones and laptops. Other common cathode materials include lithium manganese oxide (used in hybrid electric and electric automobiles) and lithium iron phosphate. Li-ion batteries typically use ether (a class of organic compounds) as an electrolyte.
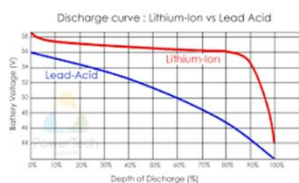

FIG: 6 Li-ion Battery

6. CONNECTING WIRE

A jump wire (also known as jumper, jumper wire, Duo Point wire) shown in Fig.7 is an electrical wire, or group of them in a cable, with a connector or pin at each end (or sometimes without them – simply "tinned"), which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering.

FIG: 7 Connecting Wire

7. ZERO PCB

Zero PCB is basically a general-purpose printed circuit board

(PCB), also known as perfboard or DOT PCB. It is a thin rigid copper sheet with holes pre-drilled at standard intervals across a grid with 2.54mm (0.1-inch) spacing between holes. Each hole is encircled by a round or square copper pad so that component lead can be inserted into the hole and soldered around the pad without short-circuiting the nearby pads and other leads. For connecting the lead of component with another lead, solder these together or join these using a suitable conducting wire.
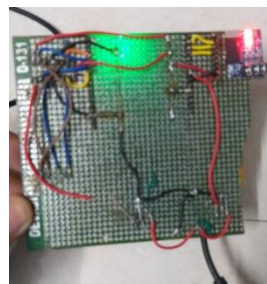

FIG: 8 Zero PCB

8. VOLTAGE REGULATOR

The function of a voltage regulator is to maintain a constant DC voltage at the output irrespective of voltage fluctuations at the input and (or) variations in the load current. In other words, voltage regulator produces a regulated DC output voltage.Voltage regulators are also available in Integrated Circuits (IC) forms. These are called as voltage regulator ICs.
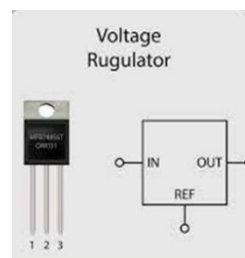

FIG: 9 Voltage Regulator

9. PROPELLER FAN

Propellers use the laws of physics to propel, or drive forward, an aircraft or a device. The basic structure of a propeller is a spinning or rotating shaft with wide, curved blades attached to it. The very simplest propellers were first used in ancient Greece, where the inventor Archimedes invented a "screw propeller" that moved water for irrigating crops.

FIG: 10 Propeller Fan

10. SOLAR PANEL

Nowadays, various solar panels are available in the market, concerning a broad range of power. When buying solar panels is considered, a 12v solar panel is one good option. Notably, 12-volt solar panels are very convenient, safe, and versatile, capable of powering different domestic and remote applications. Moreover, the affordable 12 volt solar panel price makes it one of the most commonly used solar panels. These 12v photovoltaic solar panels are fabricated from solar cells made of silicon. Such cells have a positive and a negative layer that helps generate an electric field. As these panels receive sunlight, they generate an electric current. This current gets transferred through the wires and components in the solar system for operating electrical appliances.

FIG: 11 Solar Panel

4. WORKING

The working of the project can be explained in the following steps:

Step 1: Initially power supply is given to the DTMF boat.

Step 2: Make a call to another mobile which is placed on the boat.

Step 3: Call is picked by the robot operator manually.

Step 4: Directions are given by the operator using dialing pad.

Step 5: When key 2 is pressed, boat moves forward.

Step 6: When key 8 is pressed, boat moves backward.

Step 7: When key 4 is pressed, boat moves left.

Step 8: When key 6 is pressed, boat moves right.
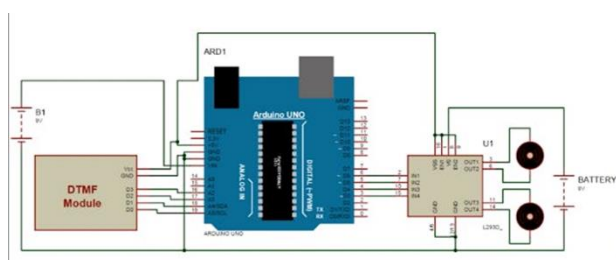
Step 9: When key 5 is pressed, boat moves stop.

FIG: 12 Circuit Diagram of this Project

Circuit diagram for this device is very similar with our other robot like Android App controlled ROBO, Obstacle Avoiding ROBO etc.. Here one motor driver is connected to arduino for driving robot. Motor driver's input pin 2, 7, 10 and 15 is connected at arduino digital pin number 6, 5, 4 and 3 respectively. Here we have used two DC motors to driver boat in which one motor is connected at output pin of motor driver 3 and 6 and another motor is connected at 11 and 14. A 9 volt

Battery is also used to power the motor driver for driving motors. A DTMF decoder attached with this circuit and this decoder is plugged into a mobile using an aux wire for receiving command or DTMF Tone. DTMF decoder pin D0-D3 is directly connected with Arduino's pin number 19, 18, 17, 16. Two 9 Volt batteries are used to power the circuit in which one is used for power the motors, connected at motor driver IC pin number 8. And another battery is connected to power the remaining circuit.

5. RESULTS

FIG: 13 Water Cleaning Machine Model

1. When we press '2' by remote phone, robot start to moving forward and moving continues forward until next command comes.
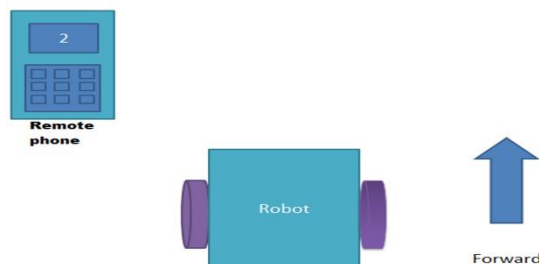
FIG: 14 Result 1

2. When we press '8' by remote phone, robot change his state and start moving in backward direction until other command comes.
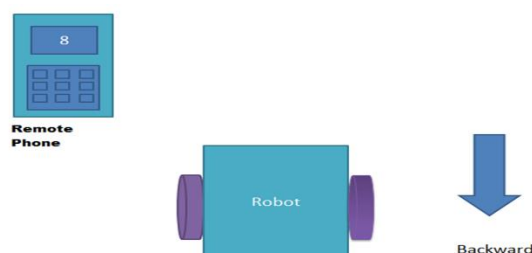
FIG: 15 Result 2

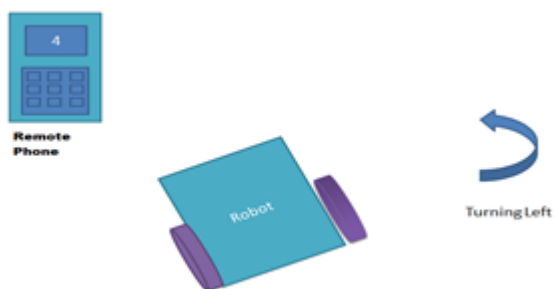3. When we press '4', Robot get turn left till next command executed.

FIG: 16 Result 3

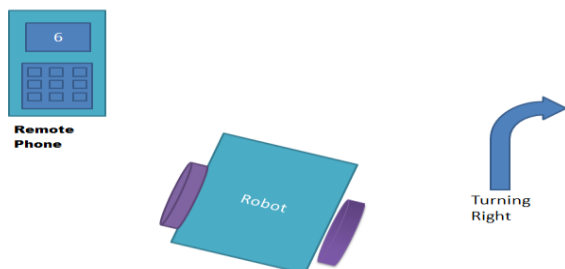4. When we press '6', robot turned to right.

FIG: 17 Result 4
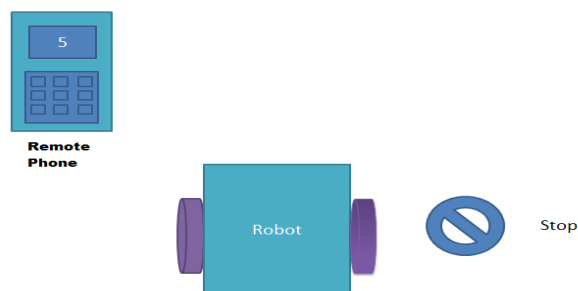
5. And for stopping robot we press '5'.

FIG: 18 Result 5

6. CONCLUSION

This project places a strong emphasis on enhancing operational flexibility while ensuring user-friendliness and low maintenance costs. The "Remote Controlled Unmanned Floating River Cleaning Machine" has been meticulously designed to offer an economical and highly efficient system for the removal of water impurities such as plastics, debris, and floating waste on river and pond surfaces. Its primary objective is to safeguard human health and promote the well-being of aquatic life.

This straightforward and cost-effective water cleaning mechanism is primarily aimed at supporting the cleanup of water bodies and the elimination of contaminants like plastics, waste, and floating debris in streams and lakes. The core purpose of this project is to preserve human health and extend the lifespan of aquatic creatures. The utilization of solar power in the canal trash removal system serves as an efficient alternative to manual drainage cleaning methods. Consequently, our project capitalizes on the cost-effectiveness

and efficiency offered by solar energy. Once implemented, this system proves to be highly effective in addressing the pressing issue of water pollution, significantly mitigating the problems associated with floating waste.

The design and analysis of this river water cleaning machine draw upon existing literature and research from various journals and papers. This approach ensures that the system is not only flexible in its operation but also easy to use and cost-effective. Moreover, there is ample room for further economic optimization and expansion of this innovative solution.

7. FUTURE SCOPE

The design of a real-time autonomous water cleaning device has been presented in this paper. This robot successfully puts forth the concept of a cost-effective system that integrates Computer Vision with the Electronic Control Unit to achieve autonomous cleaning. The design has shown tremendous promise and preferable performance when tested under several experimental conditions. Adoption of best features from existing models, make this design all the more desirable. This cost-effective solution In this project we are achieved the satellite communications with the help of DTMF technology. To overcome the short range problem of RC vehicles.

We implement this infinite range solutions into so many prototypes like drones, water driven gadjets, Delivery Bot.so that we go beyond the limits to smoother the research operations in Mining, under water operations, or air activities.

In our project we made a vehicle usef for defense purposes where with the more terrorists ambuish are inevitable for that we can disregard on Metal sensing and GPS to track the live locations of land mines. So on in future we can also made this vehicle more useful accordingly by adding some enthralling solutions like Auto Aiming, Password protections, Fire alert, Radar ,Image processing. Now day by day the world is facing the biggest problem of floating garbage. And it's increasing in tremendous amounts so it's very difficult to wash all this floating garbage due to more requirement of manpower. so, in future this remote operated floating river cleaning machine has more scope to remove large capacity of garbage automatically as fast as possible. And by making modifications during this machine, this is used for automatically removing the garbage from beaches also.

REFERENCES

1) Mr. P. M. Sirsat, Dr. I. A. Khan, Mr. P. V. Jadhav, Mr. P. T. Date, "Design and fabrication of River Waste Cleaning Machine", International Conference on Science and Engineering for Sustainable Development (ICSESD-2017) (www.jit.org.in) International Journal of Civil, Mechanical and Energy Science (IJCMES) Special Issue-1 https://dx.doi.org/10.24001/ijcmes.icsesd2017.27 ISSN: 2455-5304

2) Vivek Dhole, Omkar Doke, Ajitkumar Kakade, Shrishail Teradale, Prof. Rohit Patil, " DESIGN AND FABRICATION OF BEACH CLEANING MACHINE", International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-

0056 Volume: 06 Issue: 04 | Apr 2019 www.irjet.net p- ISSN: 2395-0072

3) Ganesh S. Patil, Rahul A. Pawar, Manish D. Borole, Shubham G. Ahire, Ajay L.Krishnani, Amit H. Karwande, "Drainage Water Cleaner Machine", International Research Journal of Engineering and Technology (IRJET) e- ISSN: 2395-0056 Volume: 05 Issue: 03 | Mar-2018 www.irjet.net p-ISSN: 2395-0072

4) Rajendra Patil, Rahul Itnare, Sagar Ahirrao, Amol Jadhav, Ajay Dhumal, "STUDY OF RIVER HARVESTING & TRASH CLEANING MACHINE", International conference on emerging trends in engineering and management resource (ICETEMR-16) 23 March 2016 ISBN 978-81-932074-7-5

5) "Madhavi N.Wagh, Kashinath Munde, "Design and
1)   Analysis of River Water Cleaning Machine" ISSN: 2455- 2631 © July 2018 IJSDR | Volume 3, Issue 7.